TOWN OF WESTFIELD
STORM WATER QUALITY
MANAGEMENT PLAN (SWQMP)

PART B: BASELINE CHARACTERIZATION REPORT

Prepared by:

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PART A: SWQMP

1.0 Introduction

PHASE II STORM WATER PROGRAM

The U.S. Congress amended the Clean Water Act (CWA) in 1987 to require permit regulations for storm water discharges. Previously, the CWA had required NPDES (National Pollutant Discharge Elimination System) permits for municipal wastewater systems. The 1987 legislation added NPDES permit requirements for municipal **s**eparate **s**torm **s**ewer **s**ystems (MS4s). This program applies to urban federal, state, county, public or private entity storm water conveyance systems that are not combined with sewage conveyances. Conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels, and conduits. Congress's goal with the Storm Water Program is to improve the water quality of degraded water bodies that do not meet water quality standards through the elimination of contributing pollutants.

The program is to apply to all storm water systems, but the requirements are being applied in a two-phase program. Phase I of the Storm Water Program applied to medium and large MS4s serving populations of 100,000 or more. The regulations also applied to construction activity disturbing five acres of land, or more, and ten categories of industrial activity. The final rule for Phase I was published in the Federal Register on November 16, 1990.

Phase II regulations implemented by EPA on December 8, 1999, expanded the program to include MS4s in urbanized areas with populations of less than 100,000. These regulations also include construction activities that disturb more than one acre of land. The federal deadline for state adoption of the Phase II program was December 8, 2002. This date was pushed back, and Indiana's rule became effective on August 6, 2003. The new Storm Water General Permit Rule was adopted by the Indiana legislature as 327 IAC 15-13, and is known as Rule 13.

IDEM mailed notification letters in December 2002 to designated MS4 entities that will be subject to Rule 13 regulations. The Town of Westfield is one of those designated MS4 entities, along with Noblesville, Carmel, Fishers, Cicero, Arcadia, and Hamilton County. The general permit application is to be submitted to IDEM within 90 days of the rule's effective date, or November 4, 2003. A second portion of the application is to be submitted within six months of the first submittal, or May 5, 2004, and the third phase of the submittal process is due six months after the second submittal date, or November 4, 2004. IDEM's required submittals are divided into three phases:

- Part A: Initial Application
- Part B: Baseline Characterization Report
- Part C: Program Implementation Plan

As part of the program, a storm water quality management plan must be developed. Major requirements of the plan include the mapping of the storm water system and the identification of illicit discharges to the collection system. The overall goal of the program is to eliminate sources of pollution that contaminate water bodies and prevent them from meeting established water quality standards. A major feature of the program is public information and education to make the public aware of the problems and enlist their support in achieving the goals of the program.

A main feature of the storm water quality management plan is what is identified as the six "minimum control measures" (MCMs). These measures are as follows: public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and municipal operations pollution prevention and good housekeeping. Best management practices and measurable goals must be established for each of the six MCMs, and these are to be implemented during the course of the five-year NPDES permit period.

The program involves other submittal requirements. Annual reports are due at the end of years two through five. An application for permit renewal is due at the end of year five. In addition, monthly summary reports of construction projects are to be submitted to IDEM throughout the program.

Designated MS4 entities had options as to how they could approach and address the requirements of the program. Each entity could have submitted an application individually, or could have become part of a joint application submittal, with one identified MS4 operator who is responsible for all entities that are a part of the application. (This requires legally binding agreements/contracts between MS4 entities.) A third option could have been to file individually but share resources or responsibilities to accomplish the program requirements. (This approach also requires legally binding agreements.)

Westfield and five other designated MS4 entities face the issue of addressing the Rule 13 requirements. The Town of Westfield decided to proceed with the third option mentioned above, which was to file an individual NPDES permit application, Noblesville and Fishers also filed individually. Hamilton County, Carmel and Cicero filed a joint permit. The Town of Westfield will share certain tasks with the County, other municipalities and with the Hamilton County Soil & Water Conservation District.

The Town of Westfield submitted Part A of the Notice of Intent on November 5, 2003. The Town of Westfield received a Letter of Sufficiency on December 5, 2003 from IDEM for the Part A submittal. Therefore, setting the date 180 days from the Part A NOI letter submittal for the Part B submittal for May 5, 2004. The NPDES general permit identification number assigned to the Town of Westfield MS4 operator is INR040109.

Contained within the content of this report and the attachments is the information which will fulfill the requirements of Part B.

2.0 Baseline Characterization

2.1 Land Use within MS4 Area

The Town of Westfield will utilize their existing Town boundaries to identify their MS4 jurisdiction (Exhibit #1). The MS4 jurisdiction will extend as the Town continues to extend their boundaries. Areas within the Town boundaries that are not annexed, are not part of the Town of Westfield MS4 jurisdiction

The Town of Westfield Planning Department and the Westfield Public Works Department met to investigate and evaluate the Town of Westfield's existing land usage within the MS4 area. The 2000 United States Geographical Survey Cover/Land Use Data map (Exhibit #2) was used as a preliminary reference map for the Town of Westfield to begin their analysis.

The Town of Westfield has a proposed land use map (Exhibit #3) that contains reference information to existing and recommendations for future proposed land usages. The use of the land use map is part of the Town of Westfield's 2020 Comprehensive Plan for managing development within Washington Township.

In order to compile a current land use map the Town utilized the Westfield Public Works Department, Development and Construction Division, which manages the Town's GIS. The GIS division was able to develop an existing land use map (Exhibit #4) from the Hamilton Counties Land Use Tax Unit Data.

The Town of Westfield's existing land uses identified and the units associated with each of those categories are summarized in Table 2.a.

Table 2.a.
Town of Westfield Current Land Use Summary

Land Use Category	Map Abbreviation	Parcel Count
Agriculture	AG	87
Commercial	COM	418
Commercial- Residential- Apartment	COM_RES_APT	15
Commercial- Residential- Condo	COM_RES_CON	190
Commercial- Residential- Mobile Home	COM_RES_MH	2
Government	GOV	39
Residential	RES	4922
School	SCH	25
Total		**5698**

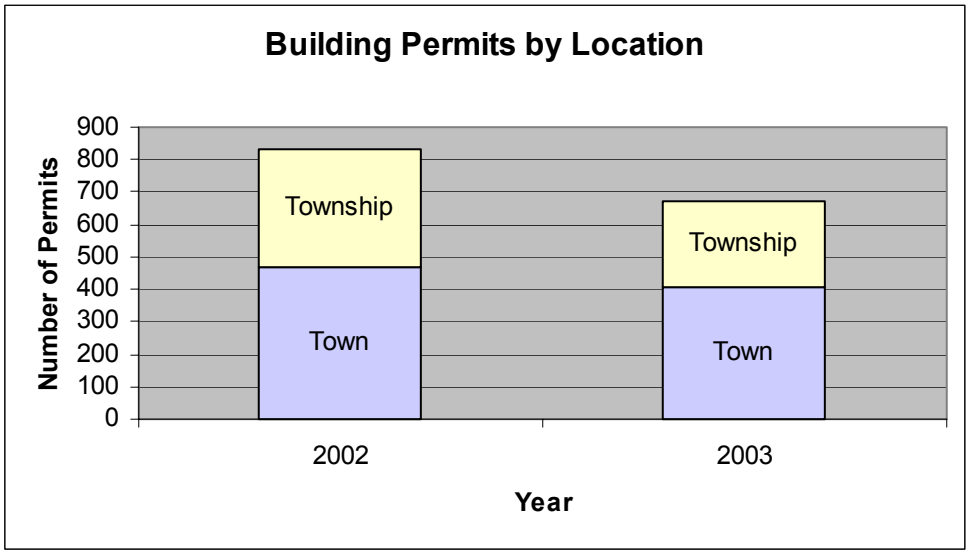
The current trend in the Town of Westfield and surrounding Hamilton County is a decrease in agricultural and pasture land uses and an increase in residential and commercial land use. The 1999 U.S. Census of Agriculture Chart (Exhibit #5) depicts and shows this trend from the 1900 to 1997. The changes in these land uses have had varying effects on not only storm water quantity but in quality.

This existing land use map will be used to identify areas, which may have a direct impact on storm water quality. The Town of Westfield Planning Department manages this land use map for all Town of Westfield uses and planning needs.

The 2000 United States Census Bureau reported the population for the Town of Westfield at 9,293, which was a population increase of 5989 from the 1990 Census Data population of 3,304. From 1990 to 2000, there was a population increase of 181.3%, which changed the Town of Westfield's State population ranking among towns and cities from 145 to 77.

The 2000 US Census Bureau statistics reported that Washington Township in Hamilton County has 6,831 housing units. For the past two years, the Town of Westfield has issued in excess of 600 residential housing permits per year. In 2002 the Town of Westfield issued 723 residential building permits with a total of 831 permits issued. In 2003 the Town issued 609 residential building permits with a total of 675 permits issued. This is a trend that the Town of Westfield foresees to continue. Below is a chart (Chart 2.1 a.) that shows the division of building permits between Washington Township and the Town of Westfield.

Chart 2.1 a.



As the correlation between land use and the growth of the Town continues more emphasis will be placed on storm water quality. The Town of Westfield will be establishing a Storm Water Utility. The Town of Westfield has formed this Storm Water Advisory Committee in order to look into the establishment of storm water fees that are fair and equitable to the storm water users within the Town of Westfield's MS4 jurisdiction.

2.2 Existing BMP Identification

The Westfield Public Works Department, Development and Construction GIS Division, will be assigned the responsibility of identifying and assessing existing structural and nonstructural storm

water best management practices (BMP's). The Westfield Public Works Department will recommend and determine the locations for future structural and nonstructural storm water BMP's practices. Current BMP's are currently being mapped using GPS equipment and will be mapped on the Town's GIS system. Future proposed BMP's installed by the Town or by future proposed developments will be GPS as-built in Indiana State Plane Coordinate System, East Zone, NAD 1983 Datum and incorporated into the Town of Westfield's GIS system. As the Town of Westfield continues to meet the mapping requirements for the storm water system for Part C, existing and proposed BMP's will be identified and incorporated into the GIS system for the Town's usage and mapping requirements.

2.3 Sensitive Water Areas

During the analysis of land uses the Westfield Public Works Department investigated sensitive water areas. The use of the land in specified areas have an impact on water quality due to their specific land uses identified in Exhibit # 4.

The Town of Westfield identified existing soils, which may have an impact on sensitive water areas. The Highly Erodible Soils Map (Exhibit # 6) within the Town of Westfield's MS4 jurisdiction was identified as having an impact on water quality due to potential erodibility characteristics. The map of erodible soils will be incorporated into the Town of Westfield GIS system and can be overlaid on the receiving waters and drainage shed map layers. The Highly Erodible Soils and Wetland maps will then be utilized during the plan review for new developments with the Town of Westfield's MS4 jurisdiction.

Potential wetland areas were identified as sensitive water areas within the Town of Westfield's MS4 jurisdiction. The Town of Westfield Wetland Map (Exhibit # 7) will also be incorporated into the Town's GIS system and will be utilized only as a reference when proposed development is planning to develop or discharge storm water within these areas. The developer will be responsible to produce validity to the classification of the potential identification of the wetland.

The Highly Erodible Soils and Wetland maps will then be utilized during the plan review for new developments with the Town of Westfield's MS4 jurisdiction.

2.4 Existing Monitoring Data

The Town of Westfield has not independently conducted any storm water monitoring programs or studies of streams or receiving waters within the Town's MS4 area. In 2002, the Town of Westfield, The City of Carmel and The Hamilton County Surveyor's Office hired Clark Dietz, Inc. to conduct a study of the Cool Creek Watershed. The study was conducted to identify each areas impact on storm water quality and quantity. Storm water observations were conducted at various locations along Cool Creek (Chart 2.4 a). For summary of results, refer to Appendix 4.2 "Project Summary and Key Findings".

Chart 2.4 a.

STREAM SAMPLING RESULTS
COOL CREEK WATERSHED MANAGEMENT PLAN

Parameter		Typical Wet Weather Values Reported in Literature	116th Street Crossing				146th Street Crossing				186th Street Crossing			
			Dry Weather		Wet Weather		Dry Weather		Wet Weather		Dry Weather		Wet Weather	
			06/21/02	09/09/02	03/25/02	08/19/02	06/21/02	09/09/02	03/25/02	08/19/02	06/21/02	09/09/02	03/25/02	08/19/02
BOD	mg/L	12[1]	<5	<5	5.1	5.5	<5	<5	5	6.9	<5	<5	5	5.4
COD	mg/L	91[1]	<10	<10	10	59	<10	9.8	10	81	<10	11	10	32
Nitrogen, Kjelhdahl	mg/L	2.35[1]	0.56	0.3	2.3	3.0	0.84	0.54	2.1	3.6	0.73	0.69	1.1	2.1
Nitrogen, Nitrate	mg/L	0.96[1]	0.65	0.47	0.9	0.69	0.85	0.16	1.2	0.81	**1.8**	0.65	**2.2**	1.2
Nitrogen, Ammonia	mg/L	0.26 - 1.1[2]	<0.10	<0.10	0.88	0.14	<0.10	<0.10	**5.1**	0.16	<0.10	<0.10	**4.3**	0.29
Nitrogen, Total	mg/L	3.31[1]	1.2	0.77	3.2	3.7	1.7	0.7	3.3	4.4	2.5	1.3	3.3	3.3
Nitrogen, Organic	mg/L	1.25[3]	0.56	0.3	1.4	2.9	0.84	0.49	<0.10	3.4	0.73	0.66	<0.10	1.8
Phosphorus, Dissolved	mg/L	0.16[1]	<0.05	<0.05	<0.05	0.15	<0.05	<0.05	<0.05	0.21	0.067	0.07	<0.05	0.28
Suspended Solids	mg/L	100[4]	<5	<5	120	**490**	<5	<5	61	**580**	<5	10	11	160
Dissolved Solids	mg/L	N/R	440	530	280	120	390	430	290	210	360	490	390	140
E coli	/100 mL	11,000[5]	170	>1600	900	1600	220	>1600	300	1600	170	>1600	900	>1600
Fecal Streptococcus	/100 mL	35,000[5]	13	3	120	920	12	<1	240	960	5	4	<10	1700
Chromium, Hex	mg/L	0.007[6]	0.01	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012
Phenol	mg/L	0.008 - 0.115[6]	0.012	0.022	<0.01	0.025	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	0.018
Copper	mg/L	0.047[1]	<0.02	<0.02	<0.02	0.033	<0.02	<0.02	<0.02	0.025	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	0.012[6]	<0.01	<0.01	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.176[1]	<0.05	<0.05	<0.05	0.095	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

(1) Nationwide Urban Runoff Program. 2300 monitored storms at 22 sites across the nation. US EPA 1983.
(2) Range is for newer suburban sites and older urban areas, as reported by Metropolitan Washington Council of Governments, 1987.
(3) Newer suburban sites, as reported by Metropolitan Washington Council of Governments, 1987.
(4) U. S. EPA database for general urban runoff.
(5) Center for Watershed Protection database of 34 recent urban stormwater monitoring studies, 1999.
(6) Metro Seattle as reported in Fundamental of Urban Runoff Management: Technical and Institutional Issues, Terrene Institute, 1994.
N/R = Not Reported
Cells shaded yellow with bold border indicate values significantly higher than national averages found in the literature.

The Town of Westfield will establish guidelines for the characterization of water quality of all known waters within the MS4 area. Visual observations once they begin to identify outfalls into the receiving streams and will be incorporated into the GIS system for reporting purposes.

The existing characteristics of receiving waters within the MS4 area are similar due to the current land uses. The existing open receiving waters exhibit similar characteristics in the regards to storm water quality.

2.5 Potential Storm Water Quality Problem Areas

During the investigation of land uses, areas that have or could cause an impact on water quality were assessed. Areas identified were retail, commercial and industrial areas that could have potential chemical storage or large impervious areas of run off that could have an impact on water quality.

In order to identify these areas the current land use map, Exhibit # 4, was used as a base map. From this base map another map (Exhibit # 8) showing potential areas was created.

3.0 Sensitive Areas

3.1 MS4 Conveyances Observations

The Town of Westfield land uses can be identified into four major types: agricultural, residential, industrial, and commercial classifications. The northern regions of the Town mostly consist of agricultural areas. These areas have the potential to contribute nitrates, phosphates and pesticide residual in the receiving waters. The middle regions of the Town consist of mixed uses, such as commercial, industrial and residential areas.

These areas have the potential to add additional nitrates, chemicals and sediment from yard applications and animal feces from

domestic pets. All of these areas contribute to trash and debris collection in storm water systems and streams.

The commercial and industrial areas have potentials for initial or accidental spills that could contribute to receiving water pollution.

The south regions of the Town consist of residential and commercial areas. The large commercial areas contain large areas of surface area that can accumulate chemical runoff.

3.2 BMP Characterization

The Town of Westfield through its Storm Water Phase II Needs Assessment (conducted by Goode and Associates, Inc.) identified various BMP's through the Pollution Prevention and Good Housekeeping BMP activities that are already in place or that could be done by the Town. Below is a list of some BMP's in place or that are recommended:

- The Town's street sweeping machine has a routine schedule to collect sediment, trash and debris for the Town's MS4 area. The WPWD has begun to track the amount of collected materials for reporting purposes.
- The Town's DPW routinely collects trash and debris from all Town owned property and along the streets. Also, the Town of Westfield has an active "Keep Westfield Beautiful Program" where community groups adopt specified areas to pick up trash and debris. The WPWD has begun to track the amount of collected materials for reporting purposes.
- The Town's DPW has begun to identify areas necessary for containment for oils, petroleum, chemicals, paints and other hazardous materials.
- The DPW has a covered salt storage facility.
- The Town of Westfield is a member of the Hamilton County Hazardous Waste Facility and Town of Westfield's residents can utilize this facility to discard their unused hazardous wastes.

3.3 Best Management Practices (BMP) Recommendations

The Town of Westfield Public Works Department is a member of the Hamilton County Storm Water Standards Committee. This committee is comprised of all Hamilton County MS4 communities. The goal of this committee is to establish a uniform Storm Water Manual for all of the Hamilton County governmental entities. In addition, this committee will define an Erosion and Sediment Control Program and Ordinances for erosion control and illicit discharge to address all components of Rule 13 for Hamilton County, which can be adopted by each community. This committee has been meeting since May 20, 2003.

The Hamilton County Storm Water Standards committee will identify Best Management Practices (BMP's) in the manual that are to be used in each community. In addition, each community can add additional BMP's to the standards as they would apply to their region or qualities of practices. These standards will be adopted by each community and will be used as a design and development tool for existing and proposed development.

The Town of Westfield does not have any combined storm/waste water systems. The Town of Westfield will begin an implementation and investigation program to identify inflow and infiltration of ground and storm water into the Town's wastewater collection system. During this process the Town will identify and recommend areas for the BMP's within the Town of Westfield's MS4 jurisdiction. Once these areas have been identified an implementation program will be recommended for placement of BMP's.

Current areas that have been identified as having a need for BMP's are the Town of Westfield and Westfield-Washington School Cooperation properties. These areas have been identified due to the large areas of impervious areas associated with these locations.

3.4 Water Quality Protection Areas

The Town of Westfield does not have any identified recreational water areas such as beaches, reservoirs or rivers. In addition, the Town of Westfield does not obtain its public drinking water from surface water sources. The Town of Westfield obtains its drinking water from two major sources. These two major drinking water sources, one of which is located within the Town of Westfield's MS4 area and the other which is located along the White River, between 146th and 160th Streets in Noblesville Township, which is in the Hamilton County MS4 jurisdiction and falls within the White River Drainage shed. All of these public drinking water sources have areas identified in the Town of Westfield's and the former Hamilton Western Utilities Wellhead Protection areas.

3.5 MS4 Quality Problem Areas

From the Storm Water Quality research that the Town of Westfield has conducted no specific receiving streams have been identified as being impaired. The majority of the Town of Westfield's HUC zones fall within the Cool Creek – Grassy Branch watershed (Exhibit # 9). Therefore, much of the emphasis will be placed in the near future on this shed. As identified in the Clark Dietz, Inc Cool Creek Watershed Management Plan areas have been identified to not only address storm water quantity but also quality. Enclosed within this report is a copy of the "Project Summary and Key Findings for the Cool Creek Watershed Management Plan" prepared by Clark Dietz, Inc.

As the Town of Westfield continues to develop and expand the Town's boundaries through annexation the other HUC receiving streams will begin to be more heavily affected.

3.6 SWQ Problem Areas

The Town of Westfield does not have any known or identified MS4 Storm Water Quality Problem Areas. Areas identified as potentially having or causing storm water quality problems are identified in Exhibit # 8, Potential SWQ Problem Areas. These areas have been identified by the Town because of the specific land use for these areas. The retail, commercial, and industrial areas have been identified due to the large amount of impervious areas associated with the uses.

4.0 - SWQMP – Part B: Baseline Characterization Report (See Appendices as attached)

4.1 SWQMP Part B Checklist

4.2 "Project Summary and Key Findings for the Cool Creek Watershed Management Plan" prepared by Clark Dietz, Inc.

References

STATS Indiana, Census 2000 Population Compared to 1990.
www.stats.indiana.edu/c2k/c2kframe.html

USGS, Land Cover/Use Data 2000/Westfield
http://129.79.145.5/servlet/com.esri.esrimap.Esrimap?ServiceName=statewide_index&ClientVers...

Indiana Department of Environmental Management. Chapter 303 (d) Listed Stream Segments. 2002.
http://www.in.gov/idem/water/planbr/wqs/303dlistcat5.xls

US Census Bureau. Indiana Business Research Center. 2002.
http://www.census.indiana.edu/

U.S. Census of Agriculture. 1999. Indiana Agricultural Statistic Service
http://www.nass.usda.gov/in/

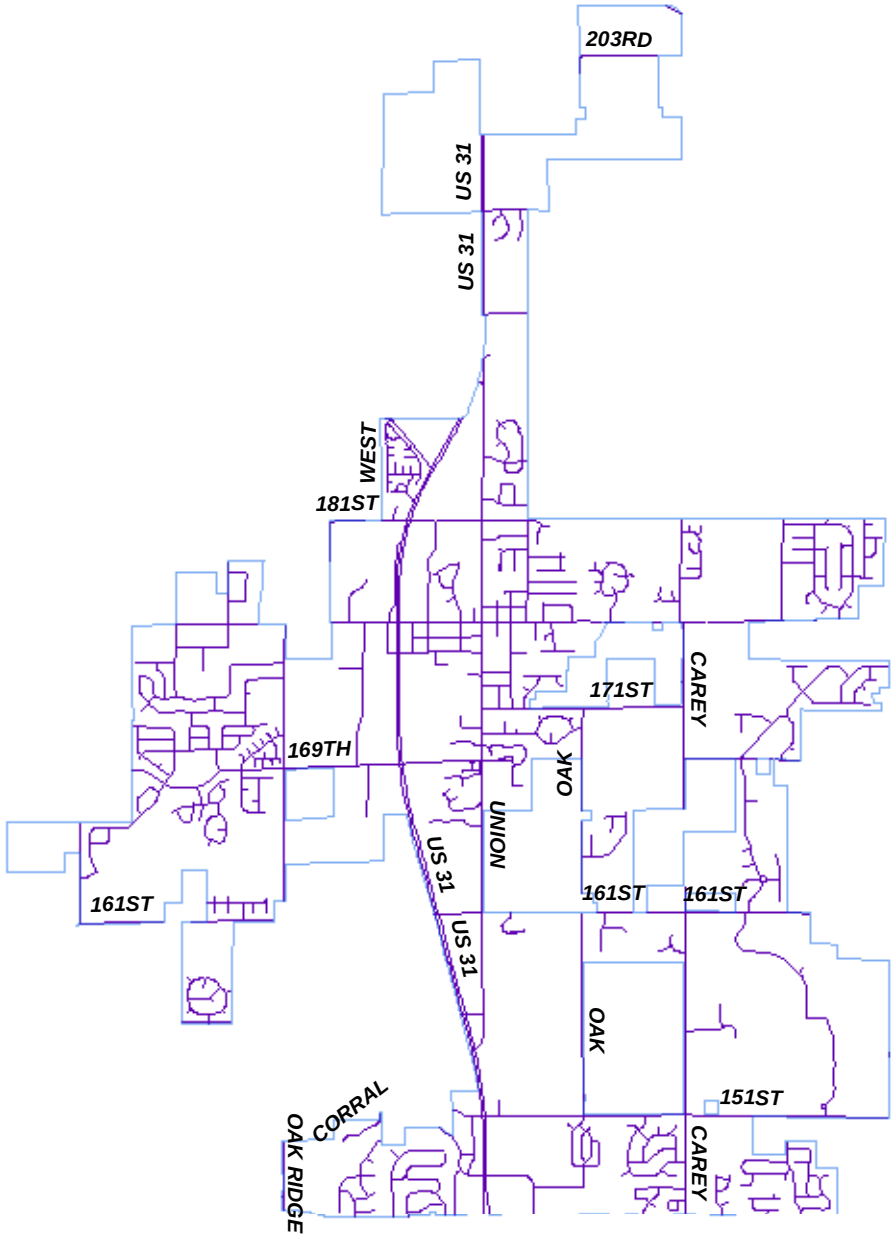
Hamilton County Online Maproom
www.co.hamilton.in.us/gis/framecounty.html

Westfield Public Works/Development-Construction/GIS Department
www.wpwd.org

"Exhibit #1"

Town of Westfield
Public Works Department
Storm Water Phase II
Part B

Westfield MS4 Areas



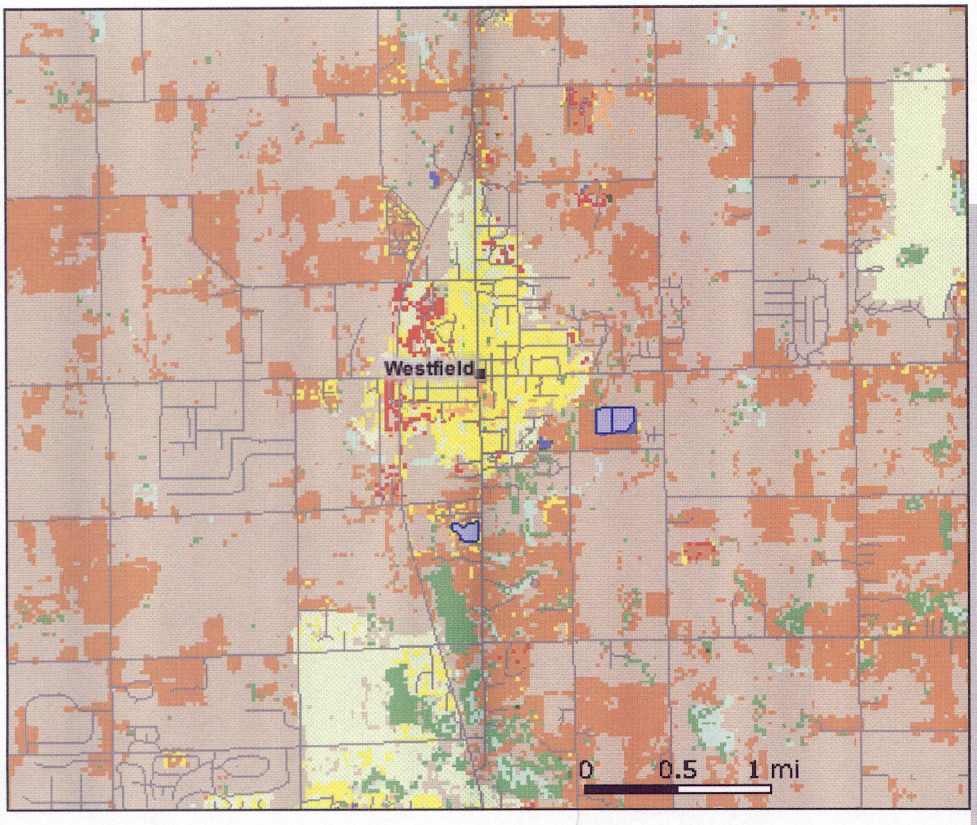
Legend
Westfield Town Limits
Westfield Streets

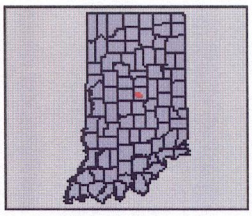
0 0.375 0.75 1.5 Miles

April 16, 2004

"Exhibit #2"

USGS Land Cover/Use Data 2000/Westfield





Legend

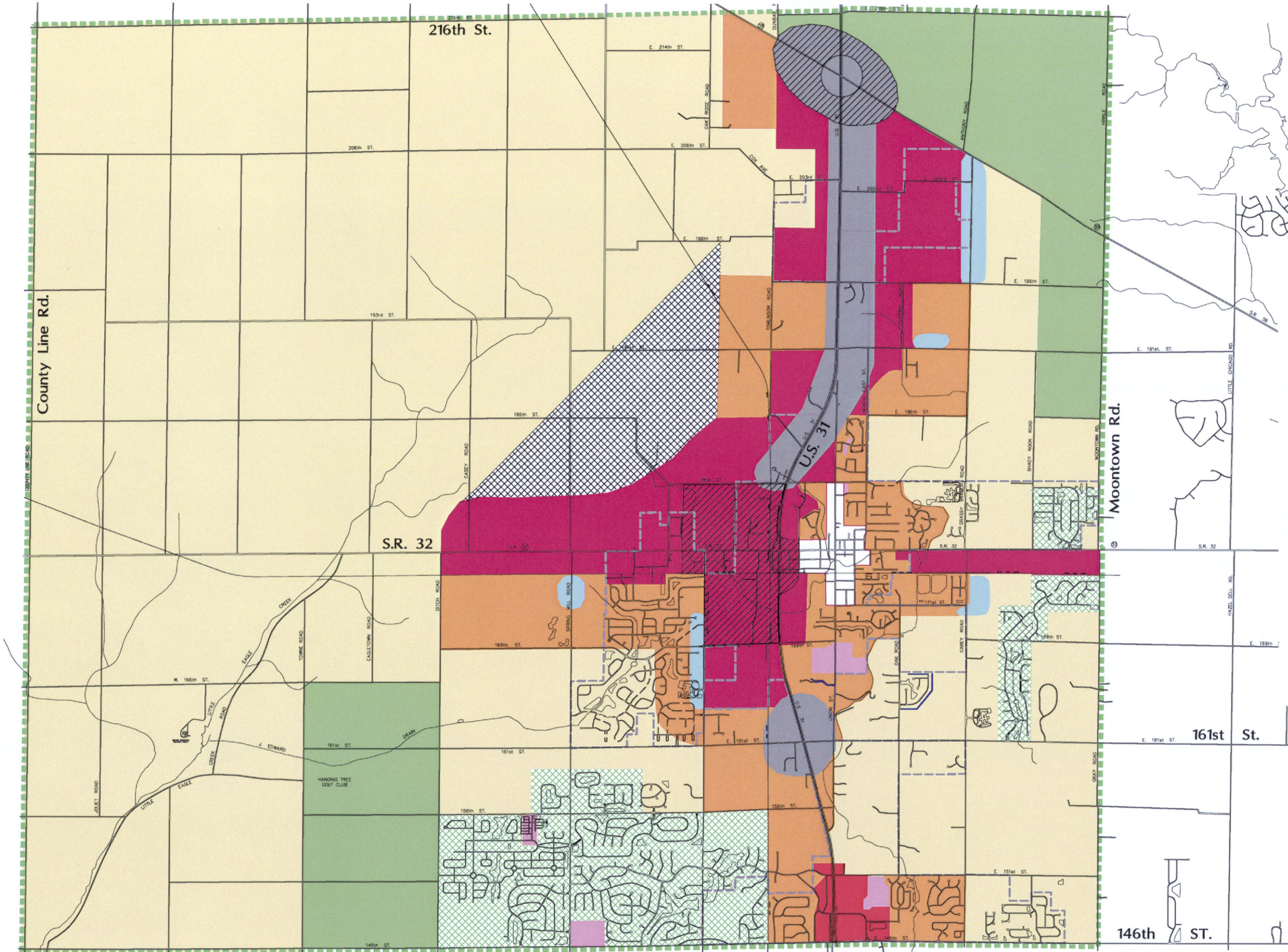
- PLSS County Boundary
- Places
- Interstate (unlabeled)
- Road (labeled)
- Hydrography Polygon
- Land Cover (USGS)
  - Null
  - Open Water
  - Low Intensity Residential
  - High Intensity Residential
  - Commercial/Industrial/Transportation
  - Bare Rock/Sand/Clay
  - Quarries/Strip Mines/Gravel Pits
  - Transitional
  - Deciduous Forest
  - Evergreen Forest
  - Mixed Forest
  - Shrubland
  - Grasslands/Herbaceous
  - Pasture/Hay
  - Row Crops
  - Small Grains
  - Urban/Recreational/Grasses
  - Woody Wetlands
  - Emergent Herbaceous Wetlands
  - Null
  - Out of range
- PLSS State Boundary

DISCLAIMER

This map was prepared by the Indiana Geological Survey, using data believed to be accurate; however, a margin of error is inherent in all maps. This product is distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability of a particular purpose or use. There is no attempt in either design or production of this map to define the limits or jurisdiction of any federal, state or local government. A detailed on-the-ground survey and historical analysis of a single site may differ from this map.

Indiana Geological Survey

"Exhibit #3"



LEGEND

3.0 EDU/Ac.	DOWNTOWN WESTFIELD HISTORIC SPECIAL STUDY AREA
3.0 EDU/Ac.	SPECIAL STUDY AREAS
1.5 EDU/Ac.	EMPLOYMENT AREAS
N/A	GATEWAY AREA
	REDEFINED DENSITIES
3.0 EDU/Ac.	RETAIL AREA
2.5 EDU/Ac.	MODERATE DENSITY SINGLE FAMILY
3.5 EDU/Ac.	MEDIUM DENSITY VARIED RESIDENTIAL
1.5 EDU/Ac.	LOW DENSITY SINGLE FAMILY
1.0 EDU/Ac.	VERY LOW DENSITY SINGLE FAMILY
7.0 EDU/Ac.	EXISTING MULTI-FAMILY AND TOWNHOUSES
1.5 EDU/Ac.	PROPOSED EMPLOYMENT AREA
	SERVICE AREA / PLANNING AREA WASTEWATER BOUNDARY
	CORPORATE LIMIT BOUNDARY

N

SCALE: 1"=4000'

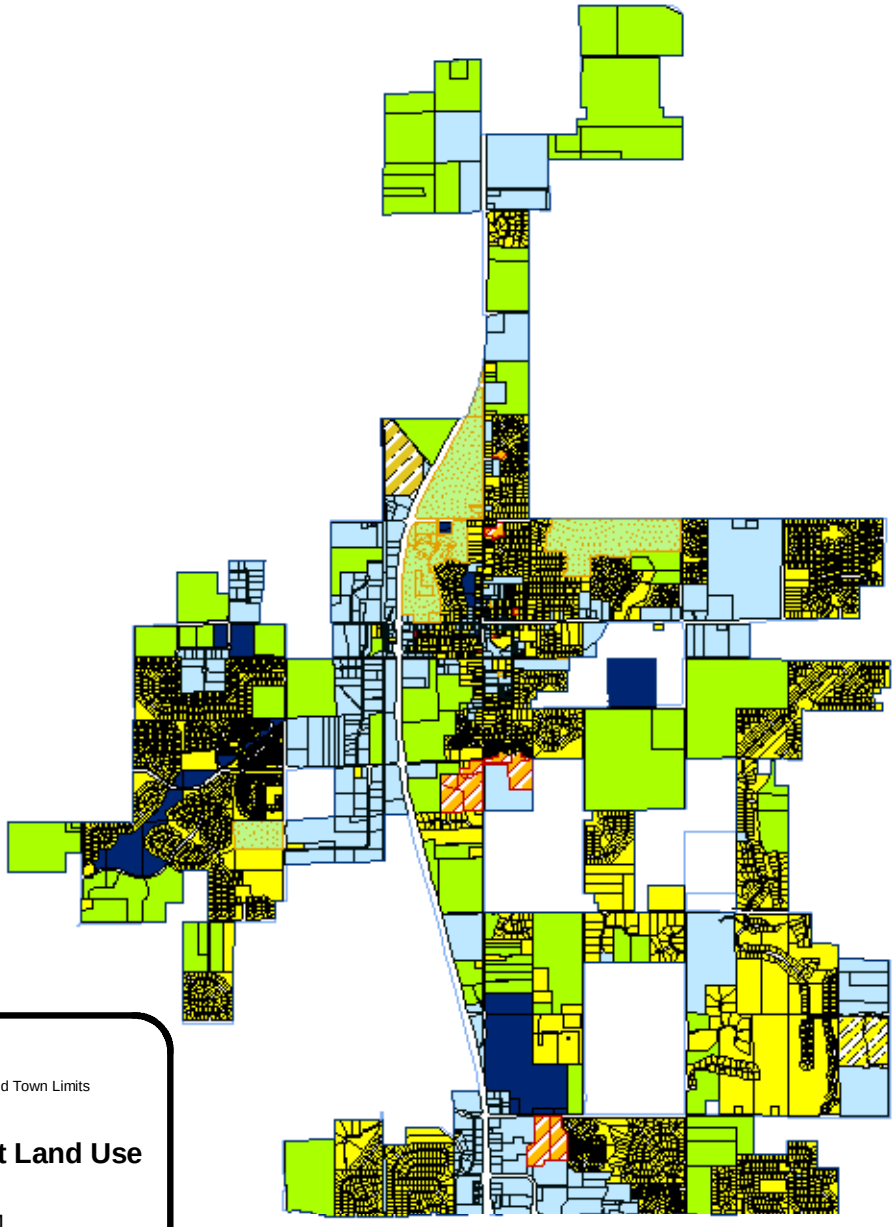
HNTB
ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

LAND USE MAP
Water and Wastewater Master Plan
TOWN OF WESTFIELD, INDIANA
OCTOBER 2003

"Exhibit #4"

Town of Westfield
Public Works Department
Storm Water Phase II
Part B

Westfield Land Use



Legend

Westfield Town Limits

Current Land Use

- AG
- COM
- COM_RES_APT
- COM_RES_CON
- COM_RES_MH
- GOV
- RES
- SCH

0 0.375 0.75 1.5 Miles

N
W E
S

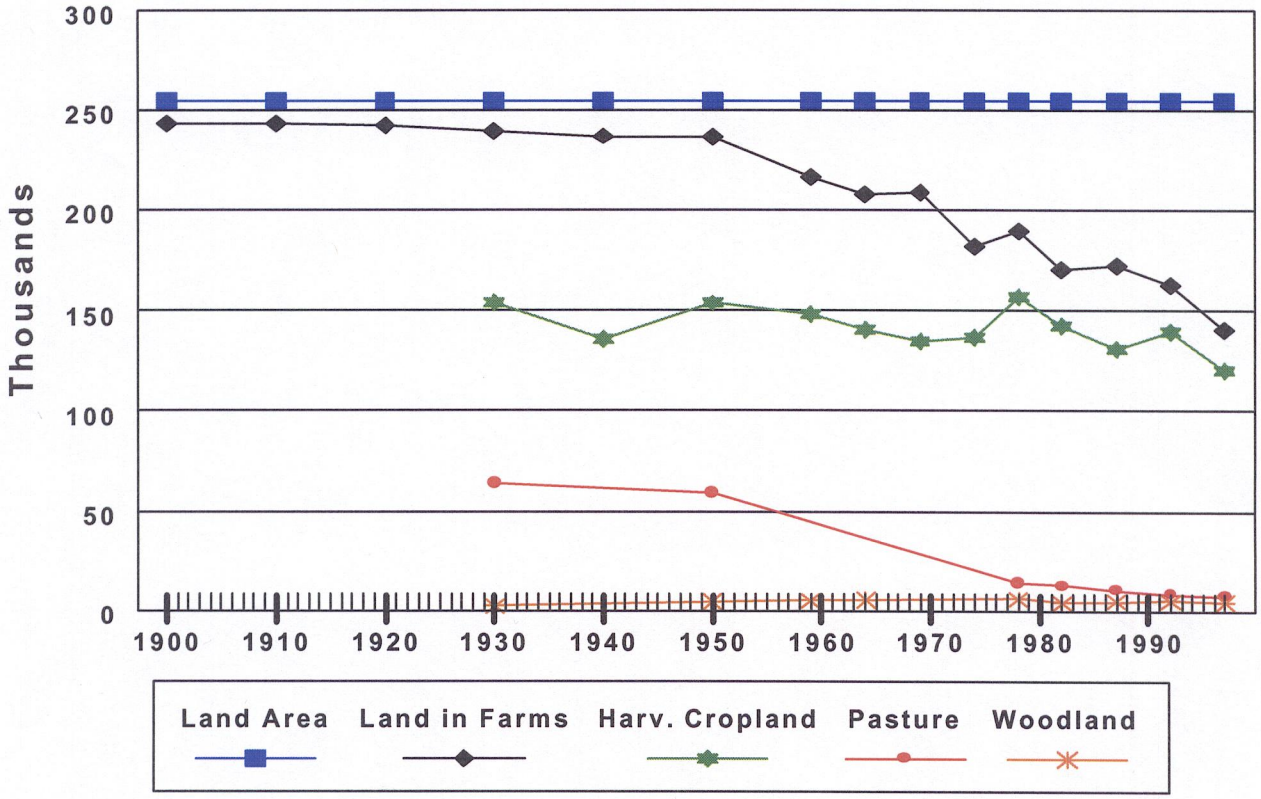
April 16, 2004

"Exhibit #5"

INDIANA FARM LAND USE HISTORY
Hamilton County, Indiana

Total Land Area 1997 - 254,731 Acres

Year	Land in Farms	Harvested Cropland	Land Pastured	Woodland Not Pastured
		------- Acres -------		
1900	243,105	n/a	n/a	n/a
1910	243,379	n/a	n/a	n/a
1920	242,165	n/a	n/a	n/a
1930	239,756	153,857	63,947	2,270
1940	237,119	135,630	n/a	n/a
1950	236,968	153,759	59,196	4,627
1959	216,917	148,291	n/a	5,249
1964	208,062	140,482	n/a	5,517
1969	209,132	134,819	n/a	n/a
1974	182,265	137,283	n/a	n/a
1978	189,804	156,756	14,023	6,155
1982	170,311	142,497	12,920	4,076
1987	172,157	130,975	10,395	4,854
1992	162,670	139,593	8,503	5,130
1997	140,813	120,531	7,608	4,537



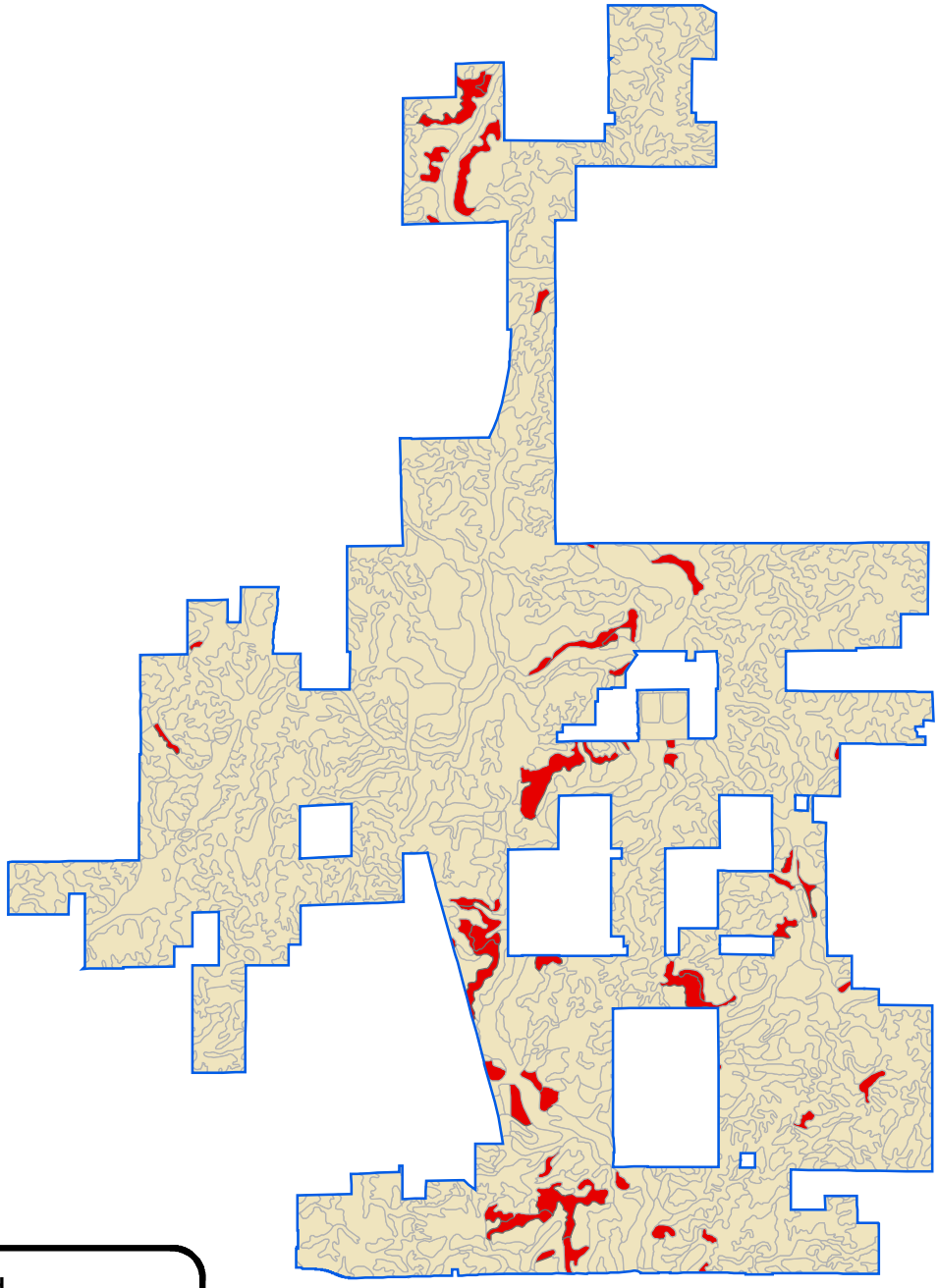
Source: U.S. Census of Agriculture
Assembled February 1999

Indiana Agricultural Statistics Service
http://www.nass.usda.gov/in/

"Exhibit #6"

Town of Westfield
Public Works Department
Storm Water Phase II
Part B

Westfield
Highly Erodible Soils



Legend

Westfield Town Limits

Highly Erodible

No

Yes

0 0.4 0.8 1.6 Miles

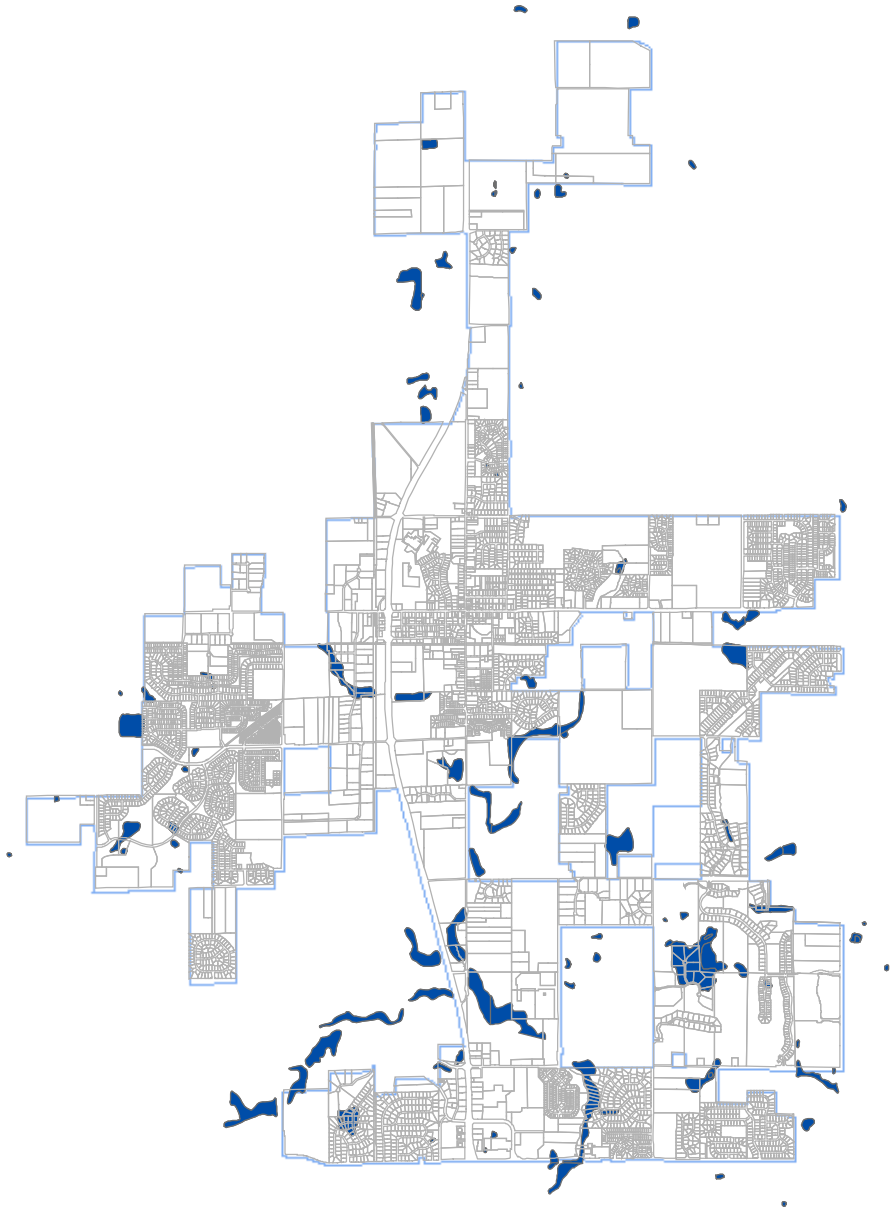
N
W E
S

13-Apr-04

"Exhibit #7"

Town of Westfield
Public Works Department
Storm Water Phase II
Part B

Westfield Wetlands



Legend

Westfield Town Limits

ParcelsWestfieldMar15

0 0.25 0.5 1 Miles

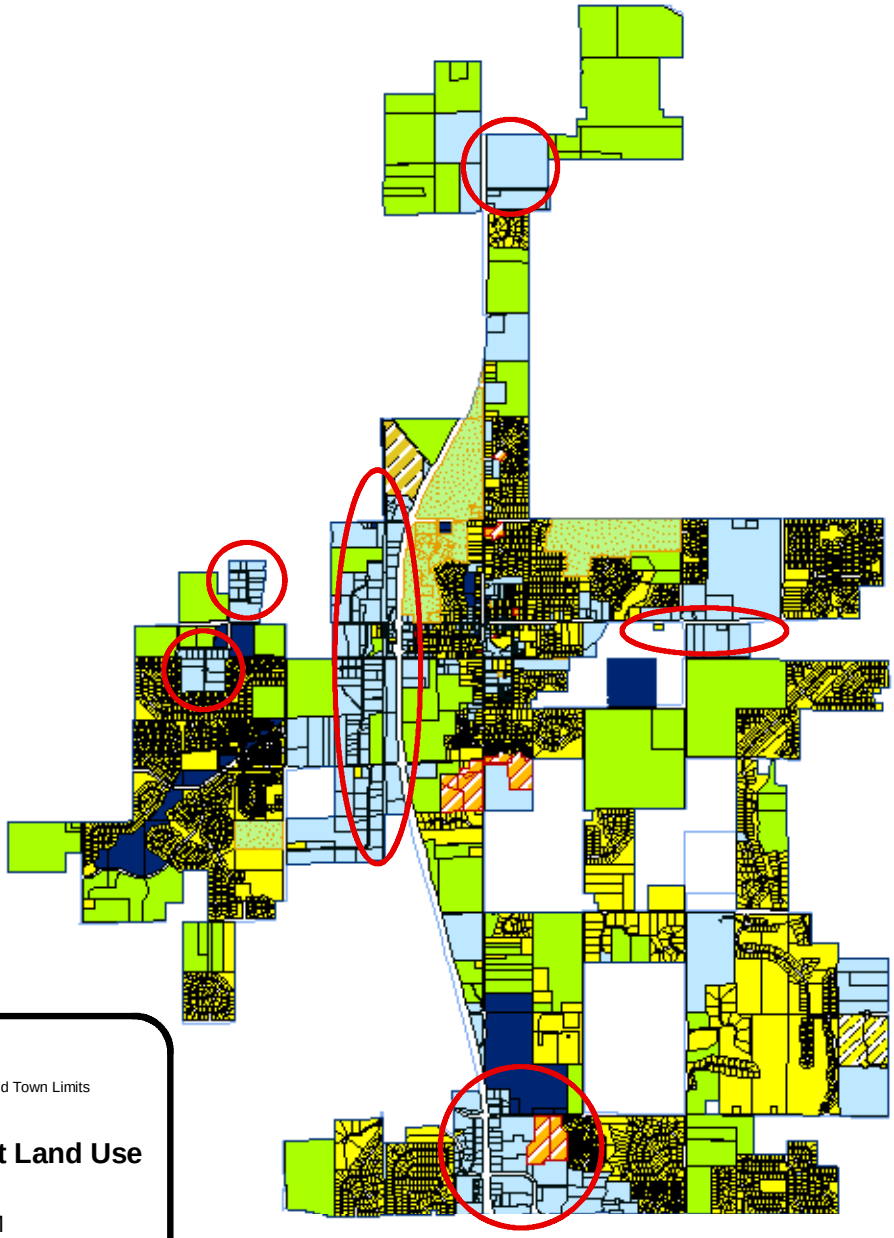
N
W E
S

12-Apr-04

"Exhibit #8"

Town of Westfield
Public Works Department
Storm Water Phase II
Part B

Westfield
Potential Storm Water Quality Problem Areas



Legend

Westfield Town Limits

Current Land Use

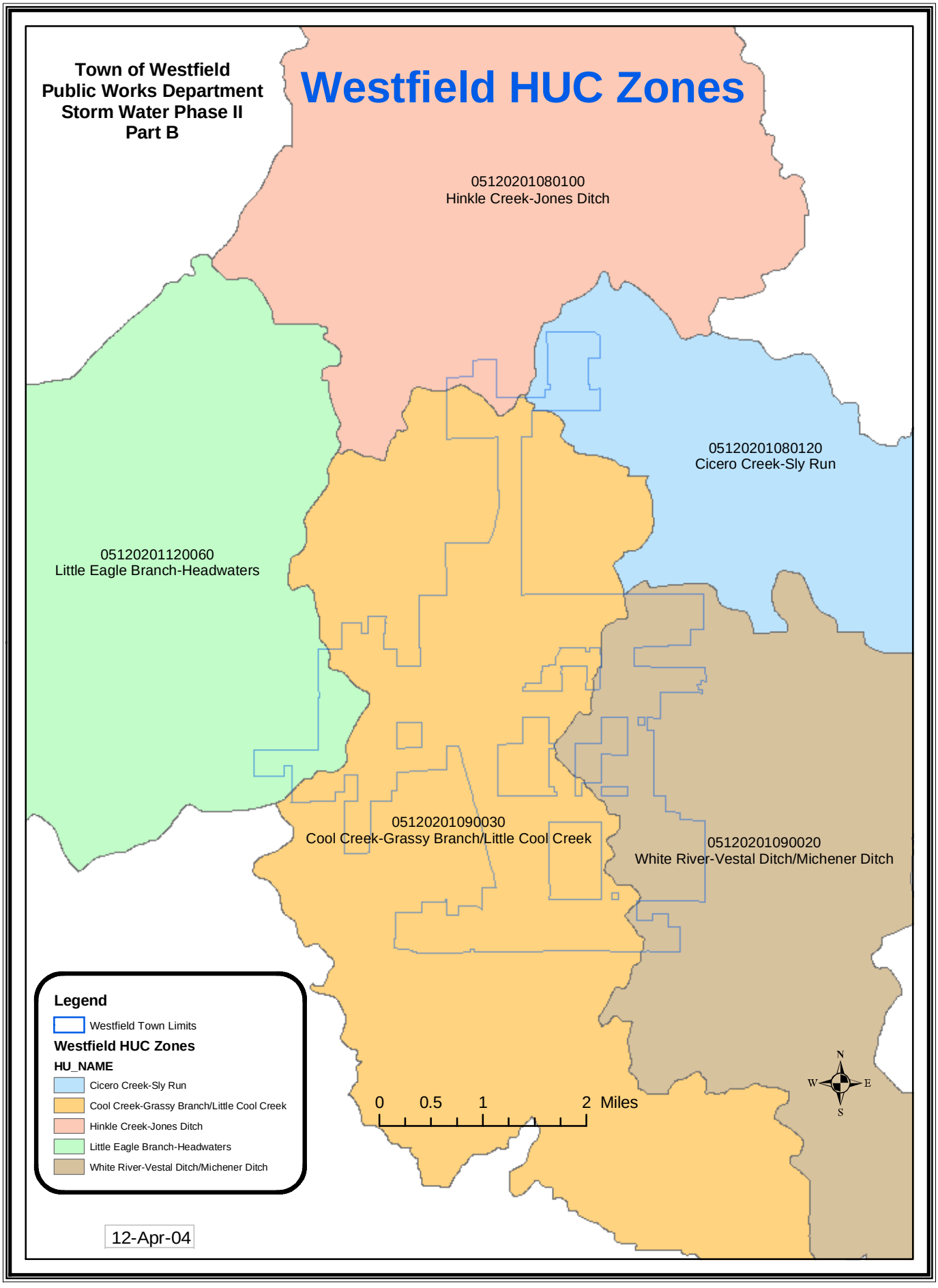
- AG
- COM
- COM_RES_APT
- COM_RES_CON
- COM_RES_MH
- GOV
- RES
- SCH

0 0.4 0.8 1.6 Miles

N
W E
S

April 16, 2004

"Exhibit #9"


Town of Westfield
Public Works Department
Storm Water Phase II
Part B
Westfield HUC Zones
05120201080100
Hinkle Creek-Jones Ditch
05120201080120
Cicero Creek-Sly Run
05120201120060
Little Eagle Branch-Headwaters
05120201090030
Cool Creek-Grassy Branch/Little Cool Creek
05120201090020
White River-Vestal Ditch/Michener Ditch
Legend
Westfield Town Limits
Westfield HUC Zones
HU_NAME
Cicero Creek-Sly Run
Cool Creek-Grassy Branch/Little Cool Creek
Hinkle Creek-Jones Ditch
Little Eagle Branch-Headwaters
White River-Vestal Ditch/Michener Ditch
0 0.5 1 2 Miles
N
W
E
S
12-Apr-04

RULE 13 STORM WATER QUALITY MANAGEMENT PLAN (SWQMP) - PART B: BASELINE CHARACTERIZATION AND REPORT CERTIFICATION CHECKLIST

State Form 51275 (R2 / 11-03)
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

For questions regarding this form, contact:
IDEM – Rule 13 Coordinator
100 North Senate Avenue, Rm 1255
P.O. Box 6015
Indianapolis, IN 46206-6015
Phone: (317) 234-1601 or
(800) 451-6027, ext. 41601 (within Indiana)
Web Access:
http://www.in.gov/idem/water/npdes/permits/wetwthr/storm/rule13.html

NOTE:

- This form must be used for compliance with a general NPDES permit pursuant to 327 IAC 15-13.
- Submit this completed form with a complete "SWQMP – Part B: Baseline Characterization and Report" in accordance with 327 IAC 15-13-7.
- Return this form, and any required addenda by mail to the IDEM Rule 13 Coordinator at the address listed in the box on the upper-right.

PART A: SWQMP CHECKLIST

► **Please check the appropriate box when the requirements for each numbered item have been met, or check "NA" if an item is not applicable. For some of the numbered items, the requirements must be met and "not applicable" is not provided as an option.**

X	NA	ITEM
☒		**1.** Plan submitted within one hundred eighty (180) days of the NOI letter submittal or the expiration date of the previous 5-year permit term
		2. Baseline characterization includes:
☒		a) An investigation of land usage within the MS4 area
☒		b) The identification and assessment of structural and nonstructural storm water BMP locations
☒		c) The identification of known sensitive water areas
☒		d) A review of known existing and available monitoring data of the MS4 area receiving waters
☒		e) The identification of areas having a reasonable potential for, or actually causing, storm water quality problems
☐	☒	f) Other (please specify):
		3. Characterization report includes:
☒		a) Conclusions, such as key observations or monitoring points in the MS4 conveyances, derived from the land usage investigation
☒		b) Characterization results of BMP locations and, as appropriate, the structural condition of the BMP, related to the BMP's potential or actual effectiveness in improving storm water quality
☒	☐	c) The characterization includes recommendations for placement and implementation of additional BMPs
☒		d) Identification of areas, such as public beaches or surface drinking water sources, that potentially or actually require added water quality protection considerations
☒	☐	e) Any correlative conclusions that can be drawn from a review of existing monitoring data that assists the MS4 Operator in identifying potential or actual storm water quality problem areas
☒	☐	f) The identification of areas or sources potentially or actually causing storm water quality problems
☐	☒	g) Other (please specify):
☒		**4.** SWQMP - Part B: Baseline Characterization and Report has been signed by a Qualified Professional and the MS4 Operator

PART B: CERTIFICATION AND SIGNATURE

► The Qualified Professional and the MS4 Operator (referenced in Part A, Item #4 of this form) must sign the following certification statement and provide the pertinent NPDES permit number:

"By signing this checklist, I hereby certify under penalty of law that this protocol was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Name of Qualified Professional: Patricia Spence. P.E.; HNTB
(typed or printed)

NPDES Permit #: **INR040** 109

Signature of Qualified Professional: _____ **Date:** _____
(mm/dd/year)

Name of MS4 Operator: Jerry Rosenberger, Town Manager; Town of Westfield
(typed or printed)

Signature of MS4 Operator: _____ **Date:** _____
(mm/dd/year)

"Appendix 4.2"

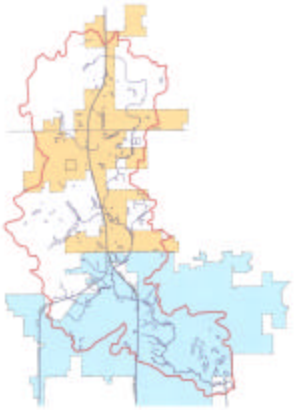
Hamilton County

City of Carmel

Town of Westfield

Project Summary and Key Findings

Cool Creek Watershed Management Plan



August 2003

Prepared for:

Hamilton County
City of Carmel
Town of Westfield

Prepared by:

Clark Dietz, Inc.
8445 Keystone Crossing, Suite 105
Indianapolis, IN 46240

CONTENTS

INTRODUCTION

The Cool Creek Watershed drains significant portions of the City of Carmel and Town of Westfield. The watershed boundary and corporate boundaries for Carmel and Westfield are illustrated in Figure 1. The watershed drains approximately 23.7 square miles, beginning at approximately 199th Street and draining south and southeasterly, discharging into the White River south of 116th Street. U. S. 31 runs through the center of the watershed. The Westfield portion of the watershed contains both urbanized areas as well as significant tracts of undeveloped land (primarily agricultural). The Carmel portion of the watershed is fully urbanized. Portions of the watershed lie in unincorporated Hamilton County, but are subject to potential annexation in the future.

Concerns over future development in the upper watershed and water quality led to the evaluation of stormwater management in the Cool Creek watershed.

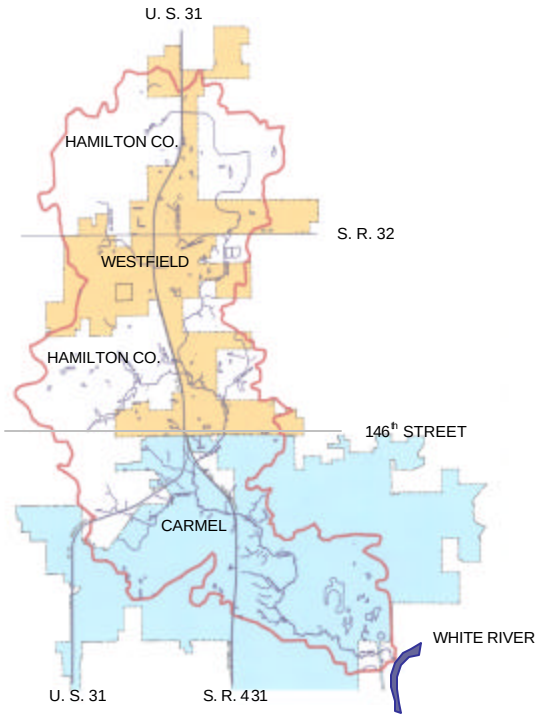


Figure 1 – Cool Creek Watershed

New state and federal regulations require Hamilton County, Carmel and Westfield to address the quality of stormwater runoff.

Recently, there has been growing interest and concern regarding stormwater management practices and their effectiveness in controlling the quantity *and quality* of stormwater runoff. This issue is of special concern given rapid growth in the Westfield area and pending requirements from United States Environmental Protection Agency (US EPA) and the Indiana Department of Environmental Management (IDEM).

New federal regulations promulgated by the US EPA and administered by IDEM require Hamilton County, Carmel, and Westfield (and other communities throughout the country) to improve the quality of stormwater runoff. Stormwater runoff is a

Controlling stormwater runoff from new development, both during and after construction, will be an important element in improving water quality.

leading source of stream impairment due to pollutants that collect on parking lots, streets, highways, commercial, industrial and residential areas and wash off during rain events. These new regulations will require communities to educate and involve the public on stormwater quality issues, minimize erosion from construction sites, improve the long-term quality of stormwater being discharged from new developments, and have good municipal housekeeping operations to minimize stormwater pollution.

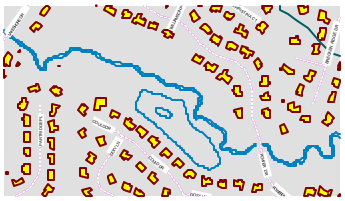
Hamilton County (through the County Surveyor's Office), Westfield and Carmel entered into an agreement in 2001 to complete a thorough evaluation of stormwater management in the watershed. Clark Dietz, Inc. was retained to develop a Cool Creek Watershed Management Plan that includes recommendations to correct existing stormwater problems and prevent future problems from occurring as the watershed continues to develop. The following is a summary of the scope of work for the project:

Inventory and Problem Identification	This work element included data collection and evaluation, staff interviews, public meetings, field reconnaissance, and problem identification.
Problem Analysis	This work element included hydrologic/hydraulic analysis and an evaluation of water quality issues in the watershed.
Solution Development	Alternative solutions were developed and evaluated under this task. Solutions ranged from bridge and culvert replacements, streambank stabilization projects, to regional detention facilities.
Conclusions and Recommendations	This work element summarized overall findings from the study and recommendations for capital projects as well as changes in stormwater management practices in the watershed.

INVENTORY AND PROBLEM IDENTIFICATION

Numerous sources of information were used to provide baseline data for the project. These sources consisted of maps and plans, previous reports and studies, ordinances and standards, and other regulatory information.

Maps and Plans



GIS data from Hamilton County were used extensively on the project

Maps and plans used on the project included:

- Geographic Information System (GIS) Maps
- USGS Maps
- National Wetland Inventory Maps
- Flood Insurance Rate Maps
- Zoning Maps
- Aerial Photographs

The maps were used to identify drainage patterns, existing and future land use, wetlands, floodplains, and other watershed characteristics.

Previous Reports and Studies

The following reports and studies were used to assist in the development of hydrologic and hydraulic analyses of the watershed:

- Indiana Department of Natural Resources (IDNR) Department Memorandum on Grassy Branch Re-Study, July 12, 2001
- Hydraulic Report for Village Farms Wilfong, July 10, 1996
- Countryside Overall System Drainage Report, August 1, 2001
- Soil Survey of Hamilton County, Indiana, U. S. Department of Agriculture Soil Conservation Service, November 1978
- Flood Insurance Studies, City of Carmel – November 1980, Town of Westfield – September 1980, and Hamilton County Unincorporated Areas – January 1987.

The Flood Insurance Studies (FIS) referenced above were being updated by the IDNR during the course of the project. The updated mapping resulting from the revised FIS was incorporated into this project.

Ordinances and Standards

Hamilton County, Westfield, and Carmel ordinances and site design standards were reviewed as they pertain to stormwater management. Carmel and Westfield both follow the Hamilton County standards, which is a key advantage in terms of providing consistent stormwater management controls in the different jurisdictions in the watershed.

Stormwater ponds control peak flows from new development.

Local site design standards require developers to provide detention facilities (ponds) that temporarily restrict stormwater runoff created by new impervious surfaces (e.g. roadways, sidewalks, rooftops) that are constructed in new developments. Ponds must be designed to limit stormwater discharge for both large and small storms. Developers are currently required to construct detention ponds that collect water from their respective developments and restrict the peak discharge to a magnitude below the pre-development condition.

Many ponds in new developments have a permanent pool of water that remains after a storm event. These ponds (often referred to as *wet ponds*) provide some water quality benefit. However, design standards for these types of ponds need to be upgraded to provide better water quality enhancement performance and protect downstream channels.

Hamilton County also has an ordinance that prohibits fill in the floodplain of any drainageway. This is a proactive requirement in that it preserves natural flood storage and also protects water quality. Carmel and Westfield (and many other communities in Hamilton County) allow development within the floodplain, provided that it meets certain standards to prevent flooding.

Problem Identification

Input from the public helped identify problems and areas of concern.

Existing stormwater problems in the Cool Creek watershed were identified using several sources, including interviews with local staff, input obtained at public meetings and through feedback from citizens, problems identified in previous studies and reports, and problems noted during field reconnaissance.

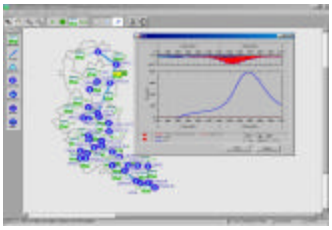
Interviews with staff from Hamilton County, Carmel and Westfield were conducted in spring 2002 to obtain historical information on drainage and flooding problem areas. Maps were annotated to show various stream flooding areas and local drainage concerns. Public meetings were held in Westfield and Carmel in May 2002 to receive input from citizens on specific problem areas or areas of concern. Field reconnaissance along all of the major stream reaches was conducted during the spring and summer of 2002. Photographs were taken documenting areas of

streambank erosion, log jams, floodplain encroachments and other problem areas.

The above information was compiled on a Problem Area Map, which is illustrated on Figure 2 (following page). This map shows the locations of neighborhoods with drainage concerns, stream reaches with debris blockages and/or erosion problems, inadequate bridges/culverts, and other information obtained during the problem identification phase.

PROBLEM ANALYSIS

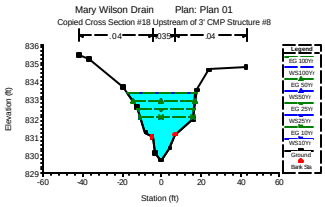
The problem analysis phase included a hydrologic/hydraulic analysis of the watershed and an evaluation of water quality issues in the watershed. The following sections describe the results of these analyses.



A hydrologic model, HEC- HMS, is used to simulate the rainfall runoff process.

Hydrologic/Hydraulic Analysis

Problems were identified and analyzed using hydrologic/ hydraulic computer models. These models simulate the rainfall runoff process and predict the volume and rate of flow that occurs during different storm events. The models are used to predict locations with flooding problems, define floodplain and floodway boundaries, and to determine appropriate solutions.



A hydraulic model, HEC-RAS, is used to predict flood elevations along the creek.

The hydrologic model was also used to simulate the cumulative effects of future development in the watershed and evaluate the appropriateness of current stormwater management requirements. As mentioned previously, developers must provide detention facilities that restrict stormwater discharge from large and small rainfall events.

The results of this analysis are illustrated in Figure 3 below which compares existing conditions (blue) and "full build-out" conditions with current detention standards (magenta). The flow vs. time graphs (hydrographs) represent the 100-year and the 1-year storms (24-hour duration) and are located at 146th Street.

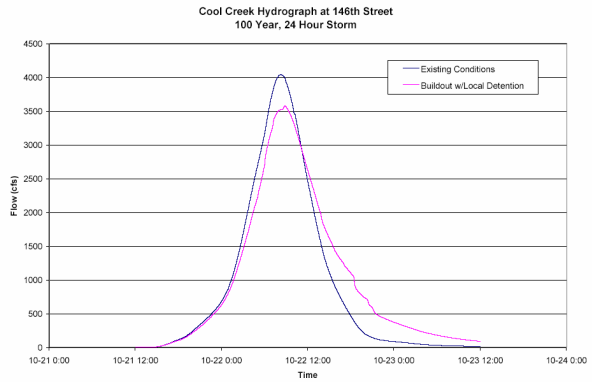
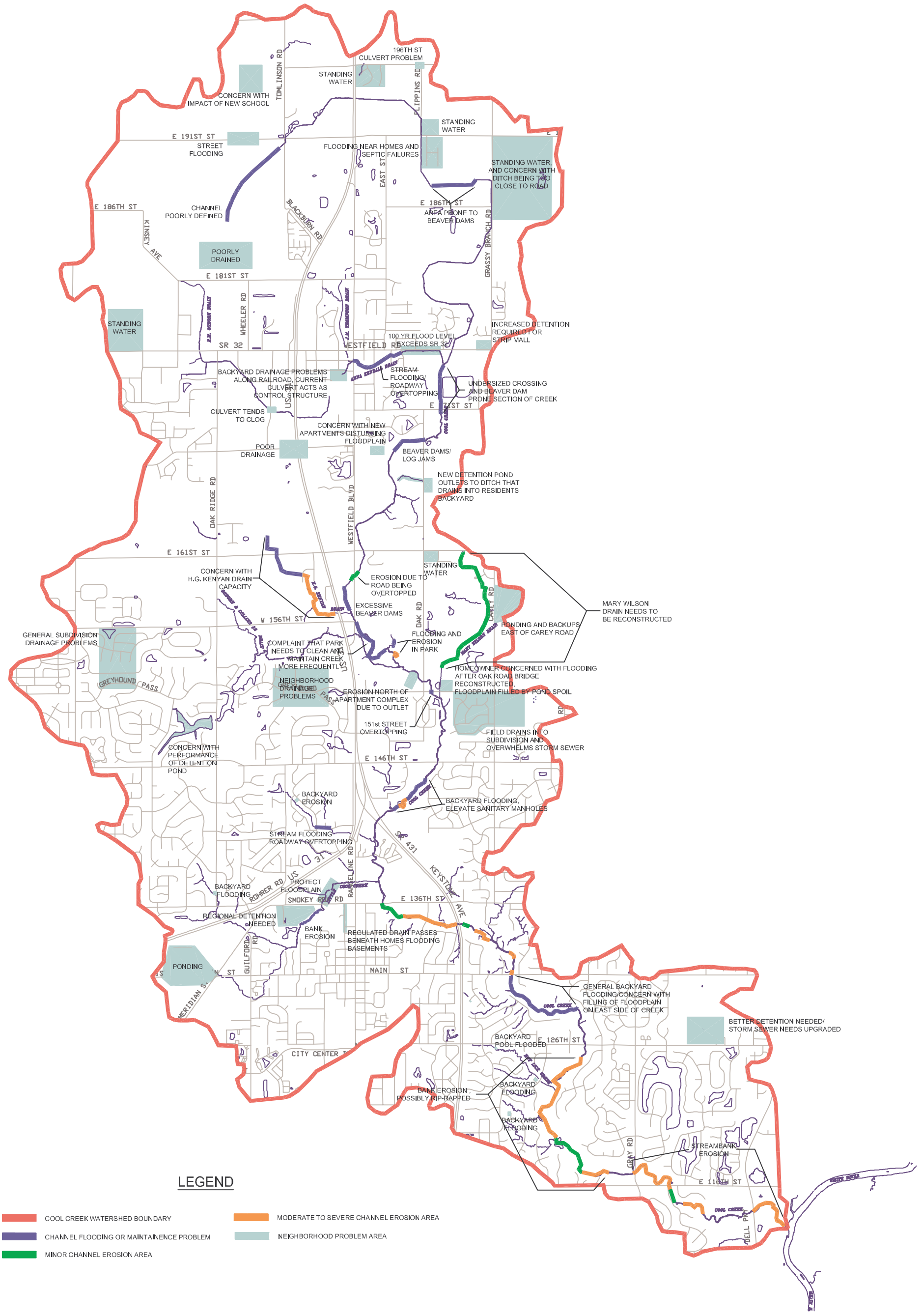


Figure 3 (1 of 2)
Hydrologic Impact of Future Development – 100-Year Storm*

** 100-year storm: A 24-hour rainfall depth that has a 1/100 (1%) chance of being exceeded in any given year*


196TH ST
CULVERT PROBLEM
STANDING
WATER
CONCERN WITH
IMPACT OF NEW SCHOOL
TOMLINSON RD
PLIPPINS RD
STANDING
WATER
E 191ST ST
STREET
FLOODING
FLOODING NEAR HOMES AND
SEPTIC FAILURES
EAST ST
STANDING WATER,
AND CONCERN WITH
DITCH BEING TOO
CLOSE TO ROAD
E 186TH ST
CHANNEL
POORLY DEFINED
BLACKBURN RD
E 186TH ST
AREA PRONE TO
BEAVER DAMS
KINSEY AVE
POORLY
DRAINED
GRASSY BRANCH RD
E 181ST ST
WHEELER RD
STANDING
WATER
SR 32
WESTFIELD RD
100 YR FLOOD LEVEL
EXCEEDS SR 32
INCREASED DETENTION
REQUIRED FOR
STRIP MALL
BACKYARD DRAINAGE PROBLEMS
ALONG RAILROAD, CURRENT
CULVERT ACTS AS
CONTROL STRUCTURE
STREAM
FLOODING/
ROADWAY
OVERTOPPING
UNDERSIZED CROSSING
AND BEAVER DAM
PRONE SECTION OF CREEK
US 31
E 171ST ST
CULVERT TENDS
TO CLOG
CONCERN WITH NEW
APARTMENTS DISTURBING
FLOODPLAIN
POOR
DRAINAGE
BEAVER DAMS/
LOG JAMS
NEW DETENTION POND
OUTLETS TO DITCH THAT
DRAINS INTO RESIDENTS
BACKYARD
OAK RIDGE RD
WESTFIELD BLVD
E 161ST ST
CONCERN WITH
H.G. KENYAN DRAIN
CAPACITY
STANDING
WATER
EROSION DUE TO
ROAD BEING
OVERTOPPED
CAREY RD
MARY WILSON
DRAIN NEEDS TO
BE RECONSTRUCTED
EXCESSIVE
BEAVER DAMS
DAK RD
W 156TH ST
PONDING AND BACKUPS
EAST OF CAREY ROAD
GENERAL SUBDIVISION
DRAINAGE PROBLEMS
COMPLAINT THAT PARK
NEEDS TO CLEAN AND
MAINTAIN CREEK
MORE FREQUENTLY
FLOODING AND
EROSION
IN PARK
HOMEOWNER CONCERNED WITH FLOODING
AFTER OAK ROAD BRIDGE
RECONSTRUCTED,
FLOODPLAIN FILLED BY POND SPOIL
GREYHOUND PASS
NEIGHBORHOOD
DRAINAGE
PROBLEMS
EROSION NORTH OF
APARTMENT COMPLEX
DUE TO OUTLET
151st STREET
OVERTOPPING
FIELD DRAINS INTO
SUBDIVISION AND
OVERWHELMS STORM SEWER
CONCERN WITH
PERFORMANCE
OF DETENTION
POND
E 146TH ST
BACKYARD
EROSION
BACKYARD FLOODING,
ELEVATE SANITARY MANHOLES
STREAM FLOODING
ROADWAY OVERTOPPING
SR 431
US 31
KEYSTONE AVE
ROHRER RD
BACKYARD
FLOODING
PROTECT
FLOODPLAIN
RANGELINE RD
SMOKEY RIDGE RD
E 136TH ST
REGIONAL DETENTION
NEEDED
BANK
EROSION
REGULATED DRAIN PASSES
BENEATH HOMES FLOODING
BASEMENTS
GUILFORD RD
PONDING
MAIN ST
GENERAL BACKYARD
FLOODING/CONCERN WITH
FILLING OF FLOODPLAIN
ON EAST SIDE OF CREEK
BETTER DETENTION NEEDED/
STORM SEWER NEEDS UPGRADED
BACKYARD
POOL FLOODED
E 126TH ST
CITY CENTER DR
BANK EROSION,
POSSIBLY RIP-RAPPED
BACKYARD
FLOODING
BACKYARD
FLOODING
CAREY RD
STREAMBANK
EROSION
E 116TH ST
COOL CREEK
BELL PARK
LEGEND
COOL CREEK WATERSHED BOUNDARY
CHANNEL FLOODING OR MAINTAINENCE PROBLEM
MINOR CHANNEL EROSION AREA
MODERATE TO SEVERE CHANNEL EROSION AREA
NEIGHBORHOOD PROBLEM AREA
NOT TO SCALE
Clark Dietz
COOL CREEK WATERSHED MANAGEMENT PLAN
PROBLEM AREA MAP

Current detention standards are effective in controlling peak flows, but longer duration flows may lead to downstream channel erosion.

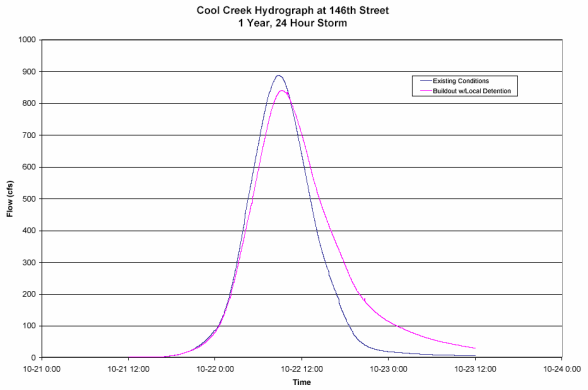


Figure 3 (2 of 2)
Hydrologic Impact of Future Development – 1-Year Storm

** 1-year storm: A 24-hour rainfall depth that has a probability of 1/1 (100%) of being exceeded in any given year*

The hydrologic analysis shows that current detention standards will be effective in controlling peak flow rates and corresponding flood elevations. However, these hydrographs also illustrate the impact of urbanization on the *volume and duration* of stormwater runoff. Under developed conditions, peak flow is reduced but it takes longer for flows to recede.

Cool Creek Upstream of 116th Street in Golf Course

Urbanization can alter the geometry and stability of stream channels. Larger and more frequent discharges that accompany watershed development cause downstream channels to enlarge, whether by widening, downcutting, or a combination of both. This is occurring in the lower reaches of Cool Creek as illustrated in the photos to the left.

Recent research has shown that traditional approaches in controlling runoff are not always effective with respect to channel stability in urbanizing areas. While the magnitude of the peak flows may not change from pre- to post-development, the duration of erosive flow increases (as was illustrated on Figure 3 above). This longer duration flow can exacerbate channel erosion.

Cool Creek Upstream of White River confluence

Newer approaches require more control (i.e. a larger required storage volume) than traditionally has been allocated to detention pond design. The premise of this approach is that runoff will be stored and released so gradually that critical erosive velocities will seldom be exceeded in downstream channels.

Channel protection from future development should be seriously considered in the Cool Creek watershed. Channel enlargement in urbanizing streams can have significant economic and ecologic implications. Studies have shown that channel enlargement can severely degrade the quality of instream habitat and diversity of aquatic species.

Water Quality Evaluation

A water quality evaluation was performed as part of the Cool Creek Watershed Management Plan. This task included a review of the general condition of the riparian corridor, an evaluation of floodplain development issues in the watershed, and water quality sampling at selected locations in the watershed.

Riparian Corridor

Forested riparian buffer along Cool Creek east of S. R. 431

The word riparian refers to anything connected with or immediately adjacent to the banks of a stream or other body of water. A riparian forest buffer encompasses the area from the streambank to the area of trees, shrubs, and herbaceous vegetation located upslope from the body of water. Buffers are established and managed to reduce the impact of adjacent land use. A buffer serves several important functions: it preserves the stream's natural characteristics, protects water quality, and improves habitat for plants and animals on land and in the water.

For a good portion of its main stem, Cool Creek has a healthy riparian forested buffer. From the mouth at the White River upstream to 116th Street, the stream corridor is forested. Between 116th Street and 126th Street, Cool Creek runs through a golf course. There are some forested areas along the creek in this reach, but not to the extent seen in other reaches. Upstream of 126th Street to approximately S. R. 32 there are healthy riparian buffers, though there are segments with limited forest cover.

No riparian buffer – Cool Creek south of 191st Street

Upstream of S. R. 32, Cool Creek has limited riparian vegetation and is farmed to the edge of the stream. Several segments of Cool Creek have been channelized and straightened. The photographs to the left illustrate the difference in riparian vegetation for the lower and upper reaches of Cool Creek. As the agricultural tracts in the upper watershed are developed, stream buffers (grass filter strips) should be considered.

Floodplain Development

A uniform policy preventing development in the floodplain would help protect water quality and protect against flooding.

Floodplain development concerns tie directly to preservation of the riparian buffers along Cool Creek (and its tributaries). Filling of floodplains can cause loss of flood storage and riparian habitat. As noted previously, Hamilton County has an ordinance that prohibits filling of land in the floodplains of its regulated drains. It may be appropriate for Carmel and Westfield to adopt similar policies for floodplains under their jurisdiction. This would provide a uniform policy and would help preserve existing riparian buffers. Many communities have adopted buffer ordinances to protect headwater streams where floodplains are often narrow and floodplain protection alone may not adequately

protect buffer systems. This management practice would also help comply with IDEM water quality regulations.

Water Quality Sampling

186th Street Sampling Point

Stream sampling was performed at three locations in the watershed: 186th Street, 146th Street, and 116th Street. Upstream of 186th Street, the watershed is mostly agricultural and includes some large properties with horse farms. The 146th Street sampling point captures runoff from most of the Town of Westfield. The 116th Street sampling point represents most of the watershed.

Two wet weather events (03-25-02 and 8-19-02) and two dry weather events (06-21-02 and 09-09-02) were sampled between the spring and fall of 2002. The total rainfall on the two wet weather events was approximately 0.7 inches (3-25-02 event) and 2.9 inches (8-19-02 event). Grab samples were collected and tested for nutrients, oxygen demand, sediment, bacteria, and other parameters that are indicators of urban stormwater runoff pollution.

146th Street Sampling Point

Table 1, located at the end of this report, summarizes the results of the sampling program. The values shaded with yellow represent sample results that were somewhat elevated as compared to national averages found in the literature. The following observations and conclusions can be made from the sampling of Cool Creek:

116th Street Sampling Point

- The constituents and concentrations of pollutants found in Cool Creek are generally comparable to urban and urbanizing watersheds across the country.

- Nutrients appear to be somewhat higher than national averages. This could be the result of excess fertilizer use coupled with agricultural runoff from the upper watershed. Public education regarding proper lawn care may be an appropriate follow up activity.

- Suspended solids were very high for one of the sampled events, though this was an atypical storm event. Proper erosion and sediment control on construction sites, in addition to streambank restoration, will help to control suspended solids levels.

- Bacteria levels exceed those required for recreational contact. This finding was expected as nearly all urban watersheds have bacteria counts that greatly exceed health standards for swimming. Efforts should be made to track and reduce human sources of bacteria that may result from failing septic

systems, illegal sanitary sewer connections, and other sources. Public education on proper disposal of pet waste would also be a best management practice to help reduce bacteria levels.

- Other management practices, such as enhanced stormwater management practices, will further reduce stormwater runoff pollution into Cool Creek and its tributaries.

SOLUTION DEVELOPMENT

Inadequate bridge – 171st St. over Cool Creek

The hydraulic analysis of the Cool Creek and its tributaries revealed that there are more severe conveyance problems in the upper reaches of Cool Creek and its immediate tributaries. Replacing undersized bridges and culverts will help to enhance public safety by reducing the likelihood of roadway overtopping during major storm events and to reduce floodplain impacts on property owners. Downstream reaches of the Cool Creek are characterized by severe streambank erosion. This is largely due to the following:

Culverts filled with sediment - Walter Street and Walter Court

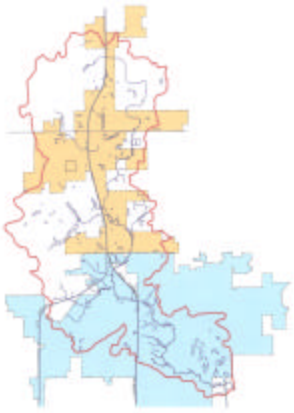
- *Aggregate effects of development in the upstream portions of the Cool Creek watershed.* Higher peak flows occur more frequently and for longer durations. These flows subject channel streambanks to excessive erosive forces. Although numerous detention ponds have been constructed in the watershed, they often do not adequately restrict flow rates for more frequent (i.e. 1-year and 2-year recurrence interval) rainfall events. These more frequent rainfall events generally dictate the tendency for channel erosion.

- *Development at or near existing channels*. Manmade features, such as residential structures, retaining walls, patios, foot bridges, and decks have been constructed within the floodplain and result in flow restrictions, higher velocities, and promote downstream streambank erosion.

Inadequate culverts – Carmel Drive over Hot Lick Creek

Proposed Solutions

The proposed solutions in the Cool Creek watershed consist of physical improvements to manmade and natural drainage features. These improvements were developed with careful consideration of the long-term health of the Cool Creek watershed, public safety, and enhancing stormwater quality. The preliminary design of bridge/culvert improvements was based on current INDOT design standards and/or the need to alleviate excessive headwater. The preliminary design of streambank restoration was based on emerging best practices for this type of improvement. Regional detention basin design was based on the need to significantly reduce flow rates resulting from frequent storm events and enhance in-stream water quality.



Proposed Improvements are as follows:

- Regrade roadway at 151st Street bridge to prevent roadway overtopping
- Replace 171st Street bridge and regrade roadway to prevent roadway overtopping
- Replace Gurley Street bridge (Anna Kendall Drain)
- Replace Cherry Street bridge (Anna Kendall Drain)
- Replace Carmel Drive culvert (Hot Lick Creek)
- Replace SR 32 (Main Street) culvert (J.M. Thompson Drain)
- Replace frontage road culvert immediately downstream of US 31 (Highway Run)
- Add a culvert to US 31 (Highway Run)
- Replace Walter Street and Walter Court culverts (Highway Run)
- Replace private drive culvert between Walter Street and Walter Court (Highway Run)
- Replace Thornberry Drive culvert (Highway Run)
- Implement seven (7) streambank restoration projects along select portions of the Cool Creek, Highway Run, and H.G. Kenyan Drain.
- Construct two (2) off-line regional detention basins to control the magnitude of stormwater flows resulting from frequent storm events and enhance instream water quality. Both detention ponds will be located in the upper portion of the Cool Creek watershed south of 171st Street and north of 186th Street.
- Anna Kendall In-Line Detention Pond. A 48-inch culvert under an abandoned railroad embankment creates a significant flood control impoundment upstream of Park Street on the Anna Kendall Drain. A breach has formed in the embankment, limiting its effectiveness. Improvements needed at this site include repairing the breach, upgrading the embankment, and installing a new control structure and emergency spillway.

The total estimated implementation cost for the recommended improvements will likely range from $8 million to $9 million. The approximate cost breakdown for bridge/culvert replacement, streambank restoration, and regional detention is 35 percent, 10 percent, and 55 percent, respectively.

Prioritization for the recommended improvements should be as follows:

1) Replace undersized bridges/culverts
2) Implement streambank restoration
3) Construct regional detention basins

CONCLUSIONS AND RECOMMENDATIONS

The following are conclusions and recommendations resulting from development of the Cool Creek Watershed Management Plan.

Conclusions

- Existing stormwater detention standards will effectively control peak flows and localized flooding as the watershed continues to develop, especially for larger storm events. However, the volume and duration of flow will increase, especially for the smaller more frequent storm events. This will lead to additional streambank erosion unless detention pond design requirements are modified to include provisions for restricting stormwater discharge resulting from the 1-year and 2-year recurrence interval rainfall events.

- The lower reaches of Cool Creek generally have a healthy forested riparian buffer. The upper reaches have been channelized and have limited riparian vegetation.

- The constituents and concentrations of pollutants found in the Cool Creek water quality sampling program are generally comparable to urban and urbanizing watersheds across the country. Best Management Practices such as public education, construction site erosion and sediment control, and enhanced detention standards will help reduce the concentrations of pollutants in stormwater runoff.

- Stormwater flooding problems are more pronounced in the upper reaches of Cool Creek and its immediate tributaries.

- The lower reaches of Cool Creek are subject to significant streambank erosion.

Recommendations

- *Implement consistent floodplain fill regulations in the watershed.* Hamilton County prohibits fill in the floodplain while Carmel and Westfield currently allow fill, provided certain conditions are met. A consistent policy prohibiting fill within the 100-year floodplain would help prevent flooding and water quality problems.

- *Implement a stream buffer ordinance.* Stream buffer preservation/enhancement such as grass filter strips, coupled with floodplain regulations, will help prevent flooding problems and improve water quality.

- *Update stormwater ordinances and design standards to more proactively address water quality*. Best Management Practices, both structural and non-structural, should be implemented to prevent or reduce urban runoff problems associated with existing and future development. Recommended practices include:

  - Modify detention policies to incorporate channel and water quality protection. Additional storage and more restrictive release rates for smaller storms will help capture stormwater runoff pollutants and reduce streambank erosion to receiving waters.
  - Identify and protect critical conservation areas such as wetlands and floodplains.
  - Encourage natural drainage protection when siting developments.
  - Utilize sound site planning practices.
  - Utilize other structural and non-structural management practices as appropriate such as porous pavement, sand filters, infiltration practices, water quality swales, manufactured devices, vegetated filter strips, and bioretention areas.

- *Construct the capital projects identified in this report.* Capital projects include eleven (11) bridge and culvert improvements, seven (7) streambank restoration projects, two (2) regional detention basins, and improvements to one (1) existing regional detention facility (Anna Kendall). These projects will enhance public safety, improve water quality, and represent a significant step towards achieving long-term environmental health for Cool Creek.

- *Use this report as a reference condition.* The findings in this report should be used as a reference condition to compare to future watershed and stream conditions and evaluate the effectiveness of stormwater management practices.

TABLE 4-1
STREAM SAMPLING RESULTS
COOL CREEK WATERSHED MANAGEMENT PLAN

Parameter		Typical Wet Weather Values Reported in Literature	116th Street Crossing				146th Steet Crossing				186th Street Crossing			
			Dry Weather		Wet Weather		Dry Weather		Wet Weather		Dry Weather		Wet Weather	
			06/21/02	09/09/02	03/25/02	08/19/02	06/21/02	09/09/02	03/25/02	08/19/02	06/21/02	09/09/02	03/25/02	08/19/02
BOD	mg/L	12[1]	<5	<5	5.1	5.5	<5	<5	5	6.9	<5	<5	5	5.4
COD	mg/L	91[1]	<10	<10	10	59	<10	9.8	10	81	<10	11	10	32
Nitrogen, Kjelhdahl	mg/L	2.35[1]	0.56	0.3	2.3	3.0	0.84	0.54	2.1	3.6	0.73	0.69	1.1	2.1
Nitrogen, Nitrate	mg/L	0.96[1]	0.65	0.47	0.9	0.69	0.85	0.16	1.2	0.81	**1.8**	0.65	**2.2**	1.2
Nitrogen, Ammonia	mg/L	0.26 - 1.1[2]	<0.10	<0.10	0.88	0.14	<0.10	<0.10	**5.1**	0.16	<0.10	<0.10	**4.3**	0.29
Nitrogen, Total	mg/L	3.31[1]	1.2	0.77	3.2	3.7	1.7	0.7	3.3	4.4	2.5	1.3	3.3	3.3
Nitrogen, Organic	mg/L	1.25[3]	0.56	0.3	1.4	2.9	0.84	0.49	<0.10	3.4	0.73	0.66	<0.10	1.8
Phosphorus, Dissolved	mg/L	0.16[1]	<0.05	<0.05	<0.05	0.15	<0.05	<0.05	<0.05	0.21	0.067	0.07	<0.05	0.28
Suspended Solids	mg/L	100[4]	<5	<5	120	**490**	<5	<5	61	**580**	<5	10	11	160
Dissolved Solids	mg/L	N/R	440	530	280	120	390	430	290	210	360	490	390	140
E coli	/100 mL	11,000[5]	170	>1600	900	1600	220	>1600	300	1600	170	>1600	900	>1600
Fecal Streptococcus	/100 mL	35,000[5]	13	3	120	920	12	<1	240	960	5	4	<10	1700
Chromium, Hex	mg/L	0.007[6]	0.01	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012
Phenol	mg/L	0.008 - 0.115[6]	0.012	0.022	<0.01	0.025	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	0.018
Copper	mg/L	0.047[1]	<0.02	<0.02	<0.02	0.033	<0.02	<0.02	<0.02	0.025	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	0.012[6]	<0.01	<0.01	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.176[1]	<0.05	<0.05	<0.05	0.095	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

(1) Nationwide Urban Runoff Program. 2300 monitored storms at 22 sites across the nation. US EPA 1983.
(2) Range is for newer suburban sites and older urban areas, as reported by Metropolitan Washington Council of Governments, 1987.
(3) Newer suburban sites, as reported by Metropolitan Washington Council of Governments, 1987.
(4) U. S. EPA database for general urban runoff.
(5) Center for Watershed Protection database of 34 recent urban stormwater monitoring studies, 1999.
(6) Metro Seattle as reported in Fundamental of Urban Runoff Management: Technical and Institutional Issues, Terrene Institute, 1994.
N/R = Not Reported
Cells shaded yellow with bold border indicate values significantly higher than national averages found in the literature.